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The catastrophic failures of plants hydraulic network examined trough an model system[1] DIANE BIENAIMÉ, PHILIPPE MARMOTTANT, CNRS and University Grenoble Alpes, TIM BRODRIBB, University of Tasmania — Plants live a dangerous game: they have to facilitate water transport in their xylem conduits while minimizing the consequence of hydraulic failure. Indeed, as water flows under negative pressure inside these conduits, cavitation bubbles can spontaneously occur.The failure dynamics of this hydraulic network is poorly studied, while it has important ecological and bioengineering implications. Here, by using dark-field transmission microscopy, we were able to directly visualize the spreading of cavitation bubbles within leaves, where the xylem conduits form a 2D and transparent network. We observe the surprising fact that the probability of cavitation increases in larger veins, where the majority of water flows. Next, in order to understand the physical mechanism of nucleation and propagation, we built artificial networks of channels made in hydrogel, where evaporation generates negative pressures. We find the hydraulic failure follows two stages: first a sudden bubble nucleation relaxing to the elastic stored of the system, and then a slow expansion driven by the flow of water in the surrounding medium. Channel constrictions slow the propagation of the bubble, similarly to the small valves that connect plants conduits.

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